

Rule-Based Multidisciplinary Tool for Unsteady Reacting Real-Fluid Flows, Phase I

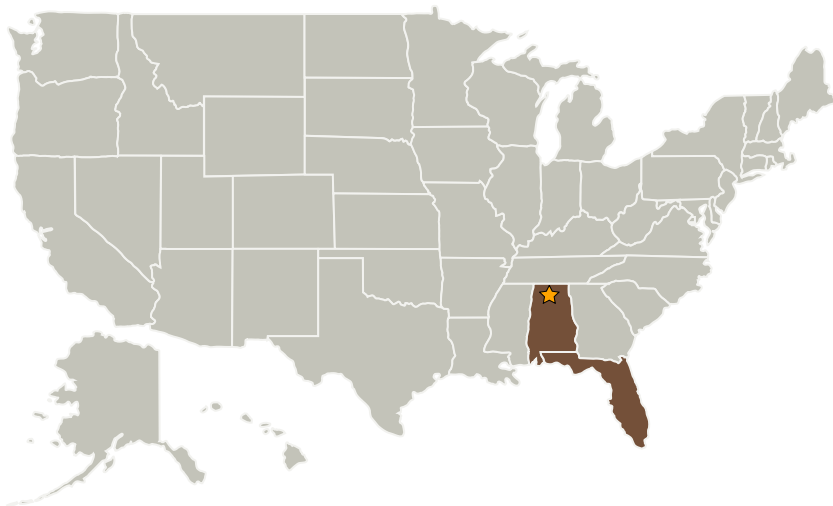
Completed Technology Project (2004 - 2004)



Project Introduction

A design and analysis computational tool is proposed for simulating unsteady reacting flows in combustor devices used in reusable launch vehicles. Key aspects guiding the development are: (a) accuracy, (b) efficiency, and (c) integration of multidisciplinary techniques. To accurately reflect the physics, the tool must include unsteady, all-speed flow modeling with real-fluid effects and be multidisciplinary, including solid-phase thermal and stress analysis. Efficiency necessitates large-scale parallel computing. Finally, the computational framework must allow an efficient integration of multidisciplinary physics. The key features of the proposed tool are: (1) a rule-based framework called LOCI which automatically handles parallel computing and multidisciplinary algorithm integration; (2) all-speed pressure-based CFD methodology (embedded in a code called STREAM); (3) unsteady flow solver with finite-rate chemistry on unstructured grids; (4) real-fluid modeling (RFM); (5) tightly-coupled multidisciplinary physics, including solid-phase thermal and stress analysis. Phase I work will consist of: (a) implementing unsteady finite-rate combustion capability into LOCI-STREAM and (b) laying the foundation for implementing real-fluid models into LOCI. Phase II will accomplish: (a) integration of real-fluid models into LOCI-STREAM; (b) integration of solid-phase heat transfer and finite element stress analysis with the fluid flow solver. The resulting CFD tool will be called LOCI-STREAM-RFM.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★ Marshall Space Flight Center (MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Streamline Numerics, Inc.	Supporting Organization	Industry	Gainesville, Florida

Primary U.S. Work Locations

Alabama	Florida
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Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Siddharth Thakur

Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
 - └ TX09.4 Vehicle Systems
 - └ TX09.4.5 Modeling and Simulation for EDL